SINGLE CRYSTAL GaN SUBSTRATE, METHOD OF GROWING SAME AND METHOD OF PRODUCING SAME

THIS APPLICATION IS A DIVISIONAL OF 10/246,559 (09/19/2002) US PATENT 6,667,184.

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Examiner.

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a single crystal gallium nitride (GaN) substrate for producing blue light emitting diodes (LEDs) and blue light laser diodes (LDs) composed of group 3-5 nitride type semiconductors, a method of growing a single crystal gallium nitride substrate, and a method of producing a single crystal gallium nitride substrate.

This application claims the priority of Japanese Patent Applications No.2001-284323 filed on September 19, 2001 and No.2002-230925 filed on August 8, 2002, which are incorporated herein by reference.

Blue light emitting diodes (LEDs) based upon the group 3-5 nitride type semiconductors (InGaN, GaN) have been manufactured, sold and used on a large scale. Almost all the practical nitride type LEDs are made upon insulating sapphire (α-Al_2O_3) substrates. Sapphire belongs to trigonal symmetry group (a=b=c, $\alpha, \beta, \gamma < 120, \neq 90$). GaN films and InGaN films are heteroepitaxially grown on a sapphire three rotationally symmetric plane for producing LEDs. On-SiC GaN type LEDs having a silicon carbide SiC substrate have been proposed and used on a small scale. On-sapphire LEDs made upon sapphire substrates have very high dislocation density of 10^9 to 10^{10} cm^{-2}. Despite great many dislocations, on-sapphire LEDs do not degenerate and enjoy a long lifetime.

Since low-cost techniques of manufacturing sapphire have been established, sapphire substrates are easily produced and are sales on the market at an inexpensive price. Sapphire is chemically stable, physically sturdy and rigid. Sapphire crystal plates have been most suitable for substrates of blue light emitting device chips. Sapphire will be favorably